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Effects of UV-radiation on feeding behavior in Dendrobates tinctorius

Taylor S. Stucky
Pepperdine University

Arthur Garnica
Pepperdine University

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Taylor S Stucky, Arthur Garnica

Mentor: Lee B Kats

Pepperdine University Natural Science Division 24255 Pacific Coast Highway Malibu, CA 90263

Abstract

UV-B levels have recently been increasing with the depletion of the ozone layer. Recent data have shown that amphibians are especially susceptible to UV-B, with poison dart frogs being one focus in these studies. The purpose of this study was to determine if UV-B radiation affects the foraging behavior of poison dart frogs. This study was conducted with a captive population of juvenile *Dendrobates tinctorius* at Pepperdine University in Malibu, California. Frogs underwent one of three treatments: UV only, Food only, and UV and Food. UV only trials were conducted using two UV lights emitting approximately 1.2 uW/cm2 of UV total on one side of the box and two identical off lights on the other side. Food only trials used flightless fruit flies in small petri dishes and empty petri dishes as control. The UV and Food trials combined these methods with the UV light over the fruit flies. The data showed that for the UV only trials, the frogs were on the UV side 39.5% of the time, indicating UV avoidance, and for the Food only trials, they were on the food only side 63.5% of the time, indicating food interest. The UV and Food frogs spent 26.9% of their time on the treatment side. We can conclude that frogs avoided feeding when the area near the food source was also exposed to low levels of UV radiation and therefore UV radiation has an effect on foraging behavior in frogs. Diurnal tropical dart frogs must balance many demands in the wild including the avoidance of even low levels of UV radiation from the sun.

Introduction

Over the past twenty years, the earth has seen a significant decrease in frog populations (Mendelson III, 2011). In part, this is attributed to cutaneous chytridiomycosis, a fungal disease that attacks many species of amphibians (Mendelson III, 2011; Pessier etal., 1999). However, frogs, specifically poison dart frogs, are quickly becoming threatened by climate change as well, (Ohmer & Bishop, 2011) needing to be conserved quickly. This study looked at the effects of UV-B radiation on feeding behavior to help better understand how to conserve these frogs in the face of climate change.

These tiny frogs of the tropical rainforest ranging from Costa Rica to Brazil (National Geographic) are known for their brilliant coloring and poison skin. It is undisputed that over the past several years the temperature on earth has been creeping upward. This effect, know is global warming, is attributed to a myriad of sources; however, the consequences of global warming are seen daily. One such consequence is the depletion of the ozone layer, the protective layer of O_3 molecules in the earth's atmosphere that keep ultraviolet (UV) radiation from penetrating the earth. Certain chemicals containing chlorine, when reacted with the ozone layer, turn the O_3 into O_2, depleting the protective ozone layer. This results in an increase in the amount of UV radiation that reaches the surface of the earth (Campbell etal., 2008). It has been found that many species are being affected by this flux of UV radiation. Ultraviolet B (UV-B) has been shown to harm certain species of fish (Little & Fabacher, 1994), and recent data has shown that amphibians are especially susceptible to UV-B, with poison dart frogs being a main focus in these studies.

Beginning at the tadpole stage, exposure to UV-B causes premature hatching which reduces predation survival (Alton etal., 2011). UV-B exposure in the developmental stages causes decreased fitness in later life for frogs, including malformed limbs (Pahkala etal., 2006; Cohen, 2001), ultimately harming the species. Experimentation in Costa Rica demonstrated that poison dart frogs avoid areas of high UV-B radiation (Han etal., 2007). Though frogs do have UV-B defense mechanisms, including behavioral changes, the increase in UV-B over the past few decades is making it harder for the frogs to cope (Blaustein & Belden, 2002). Their only hope may be avoiding UV-B as much as possible.

All species deal daily with balancing conflicting demands. Past research has looked at balancing conflicting demands in different frog tadpole species in regards to predation and foraging, but no research has been conducted on balancing UV-B avoidance and foraging in juvenile frogs, which is the goal of this study (Horat & Semlitsch, 1994).

Dendrobates tinctorius

Hypothesis

Poison dart frogs will avoid flies under UV-B light and will show interest in those not under UV-B light to preserve themselves from the harmful radiation effects.

Methods

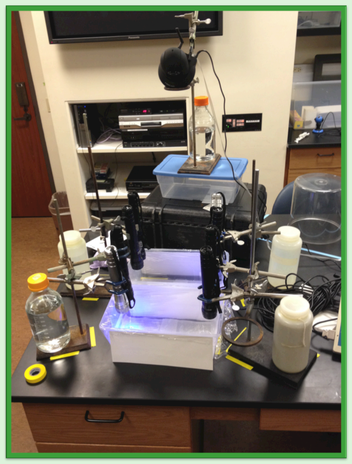

Fig. 1. Two trials were run at a time with a camera mounted above. Each box had the ability to do Food only, UV only and Food and UV trials

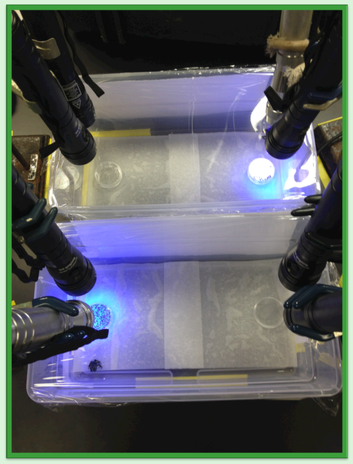

Fig. 2. Pictured are two Food and UV trials being run

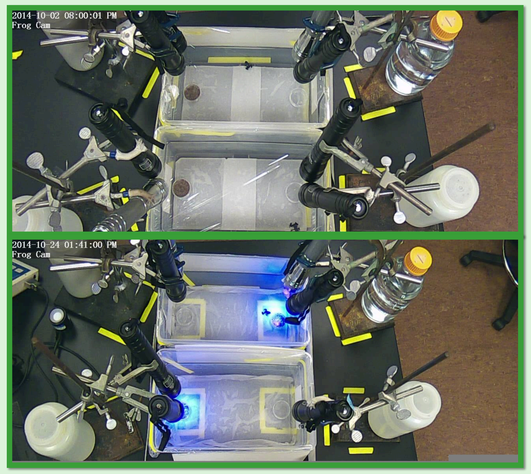

Fig. 3. The frogs were monitored using video surveillance in real time with screen shots of position taken every five minutes.

Results

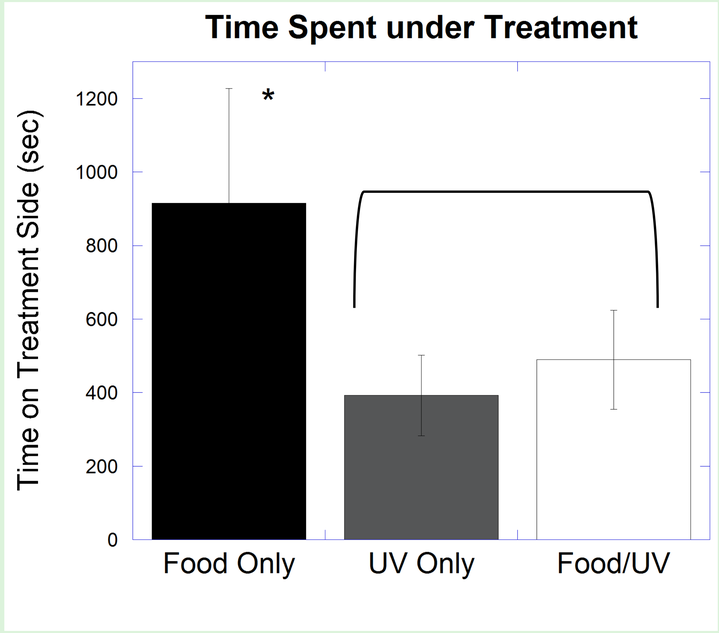

Fig. 5. Comparison of time spent within 2 cm of treatment for each group. Data analyzed using an unpaired, one-tailed, students' t-test, $p < 0.05$. Significance between Food only group and UV only and Food/UV groups together denoted by *.

Conclusions

1. As has been shown with other dart frogs, juvenile *D. tinctorius* avoid low levels of UV radiation.
2. Juvenile frogs, are attracted to petri dishes with food, but the attraction is lost when the food is also in an area of low UV.
3. If UV levels are increasing in tropical regions because of ozone depletion or deforestation, dart frog feeding behavior could be impacted.

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